BOOK REVIEW 2009 - #1

Hay, Robert K.M. and John R. Porter. The Physiology of Crop Yield. 2006. Second Edition. viii + 314 pages; tables; figures; one photomicrograph; one scanning electron micrograph; references; index. Blackwell Publishing Professional, Ames, Iowa. ISBN-13: 978-14051--0859-1. Soft Cover. Price: U.S. $59.99. Available from: Blackwell Publishing Professional, PO Box 570, Ames, IA 50010-0570

Since I did not have the benefit of using the earlier edition of The Physiology of Crop Yield, the present edition is the first edition I examined. My first quick read through its pages gave me the impression that it is a valuable book.

After the excellent introductory remarks in the first chapter, chapter two introduces the reader to the fascinating relationships between form and function of plant structures. The treatment of indeterminate growth (formation of more leaves and growth of stem after flowering) of Soybean (*Glycine max*) is succinctly done, explaining the difference between the indeterminate stem growth and indeterminate leaf appearance. Similar specific detailed analyses are provided for Potato (*Solanum tuberosum)* and Corn (= Maize; *Zea mays)* that will be of particular interest to students and professionals in the plant sciences in the United States, especially the Midwest.

The next two chapters (three and four) deal with solar radiation interception and photosynthesis. The discussion has a special emphasis on leaf area index and canopy architectural expansion in relation to solar radiation. Using a systems biology approach, the authors examine photosynthesis at three structural levels -- the cell, leaf, and canopy. Distinctive photosynthetic responses in terms of radiation use efficiency and the accumulation of sugars at these three levels are discussed. The authors are aware that there has been criticism concerning the utilization of radiation use efficiency for this purpose by some researchers. On the other hand, they made efforts to explain the differences in net photosynthesis at the cell, leaf, and canopy levels with respect to leaf growth and expansion, branching, and canopy architecture and expansion.

The next chapter (five) deals with the release of carbon dioxide during respiration. The relations among respiration, photosynthesis, synthesized biomass, and environmental factors are highlighted. Utilization of different substrates for respiration in relation to maintenance and growth of plants are treated in detail. Calculations of respiration associated with growth, enzyme functions (such as nitrate reductase), nitrate uptake, ion uptake, and phloem loading are explained. In addition, the authors briefly discuss the effects of elevated carbon dioxide on respiration and dry matter production. In C_3 plants, dry matter production increases with some increases in carbon dioxide levels, thereby providing more substrates for respiration.

Chapter six deals with the dry matter distributions among different plant structures not only their harvested parts. In essence, this is a detailed discussion of source-sink relationships. The relationship between ontogeny and pattern of partitioning of dry matter in relation to the expanding leaves is explored. Moreover, the role of source and sink limitations on yields is considered with specific emphasis on selected cereals – Corn (*Zea mays*), Barley (*Hordeum vulgare*), and Wheat (*Triticum aestivum*); as well as the tuber

crop, Potato (*Solanum tuberosum*). Additionally, the discussion on assimilate partitioning in grassland plants is very useful with the present trends towards developing bio-fuel crops.

Chapter seven deals with the consequences of limiting factors on crop yield. Two major limitations are considered – water and nitrogen. Water use efficiency and crop yield under limited water supply is discussed. A considerable discussion on drought avoidance by plants is provided, but drought tolerance is discussed only briefly. The acquisition of water and water use efficiency and the acquisition of nitrogen and nitrogen use efficiency in crop yield are dealt with in detail. Perhaps I am particularly interested, but I was slightly disappointed not to see any treatment of other soil factors such as salinity problems. Water deficiency and salt stress are interrelated and thus, a discussion of salt stress might well have been considered.

The next two chapters (eight and nine) deal with the physiology of crop quality and problems in modeling of crop growth and yield. Three models – AFRC2 for Wheat, CROPGRO for Soybean and the Muchow and Sinclair Model for Maize are discussed in detail. Also, the authors give the readers who are not familiar with modeling a thorough explanation of how these models are derived and what their limitations are. I was happy to see that the authors, themselves, expressed a cautionary note on the limitations of models in chapters three and four.

The last chapter, albeit a small one, is noteworthy in providing suggestions for future research. The potential for increasing crop yield with lower inputs and more research on cropping systems under various climatic conditions are mentioned. Also, a closer working cooperation among molecular biologists and crop physiologists is suggested, which most of us would strongly support.

Except for a minor disappointment in not seeing the effects of salt stress on crop yield covered, I certainly enjoyed the book. The authors have succeeded in presenting the subject matter in a thorough and concise manner. According to the authors, this book is meant for senior undergraduate students, but I recommend it to graduate students of crop physiology as well. In addition, agriculturists, agronomists, and regional land use planners need to have The Physiology of Crop Yield readily available.

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